AIR MATTRESS WITH PRESSURE CONTROL SYSTEM

The present invention relates to a mattress, and in particular to a mattress in which the support of the user's body can be adjusted in a manual or automatic manner.

Some known mattresses comprise an external cover in which a padding including one or more air chambers suitable for being inflated for supporting the body of at least one user is arranged. However, the pressure inside these air chambers is fixed or, as in the case of the medical mattresses for preventing decubitus ulcers, is periodically changed with alternated pressures in the adjacent air chambers, so that the user cannot directly intervene for modifying in a stable manner the support of the mattress according to his comfort needs.

US 5142717, US 2003/0221261 A1 and EP 663169 disclose mattresses comprising air chambers connected to an electric compressor by means of an air inlet provided with a valve which is opened or closed by a control unit according to control signals coming a pressure sensor. However, these air chambers are relatively wide or long, so that the air pressure supporting the users cannot be precisely controlled and/or adapted according to the users' weight, position and movements on the mattresses.

It is therefore an object of the present invention to provide a mattress which is free from said disadvantage. Said object is achieved with a mattress, the main features of which are disclosed in the first claim and other features are disclosed in the subsequent claims.

Thanks to the electric compressor, the electric valves, the pressure sensors and the control unit, the users can adjust in a precise and stable manner the pressure in the mattress according to the present invention, which is preferably provided with more groups of air chambers in which the pressure can be adjusted in a different manner for each portion of the body, so as to improve the user's comfort.

According to a particular advantageous aspect of the invention, the groups of air chambers can be obtained by an upper sheet of a deformable material, which is shaped and welded to a lower sheet so as to obtain in a simple and inexpensive manner not only a plurality of alveoli for the air chambers, but also the ducts which mutually connect these alveoli in each group of air chambers.

User's weight	Zone A	Zone B	Zone C	Zone D
15-40 kg	14660-15330	17995-19330	16660-17995	15330-16660
40-50 kg	14660-15990	17330-18670	16660-17995	15330-16660
50-60 kg	14660-15990	16660-17995	16660-17995	15330-16660
60-70 kg	15330-16660	15990-17330	15330-16660	15990-17330
70-80 kg	15330-16660	15330-16660	14660-15990	15990-17330
80-90 kg	15990-17330	15330-16660	13990-16660	15990-17330
90-100 kg	15990-17330	14660-15990	13330-14660	15990-17330
100-110 kg	16660-17330	12660-13990	12660-13990	16660-17995
110-120 kg	16660-17330	11330-12660	12000-13330	16660-17995
120-130 kg	17330-18670	9990-11330	11330-12660	17330-18670
130-140 kg	17330-18670	9990-11330	10665-12000	17330-18670
140-150 kg	17330-18670	9330-10665	9330-10665	14660-15990

Table 1: standard pressure values

The user can therefore input his own weight by means of keyboard 25 of the remote control 22, so that the control unit 15 loads from the digital memory 21 the series of pressure values corresponding to said weight. These values correspond to the inner pressure of the air chambers 3 without the user on the mattress and may vary according to the control signals sent by the user through keyboard 25 of the remote control 22, so that the user can increase or decrease the pressure in one or more air groups of chambers 3 according to his needs. In any case, the standard or the user's settings are detected by the pressure sensors 20 and stored into the digital memory 21 when no force is exerted onto the air chambers, i.e. when the user does not lie down on the mattress, so as to obtain a greater reading precision.

The control device 5 therefore acts as a manostat by suitably opening or closing the electric valves 14 or 16 and/or the automatic switch 18 for keeping the pressure constant, for example within a range of 500 Pa, in one or more groups of air chambers 3 according to the real pressure detected by the pressure sensors 20 and to the ideal pressure values stored in the digital memory 21. All these pressure values can be transmitted in real time from the control unit 15 and displayed by display 24 of the remote control 22.

According to another particular advantageous aspect of the invention, the control unit is provided with a digital memory and can communicate with a remote control, so as to automatically adapt the pressure in each group of air chambers according to the user's weight and/or to modify said pressure for further improving the comfort of the same user.

Further advantages and features of the mattress according to the present invention will become clear to those skilled in the art from the following detailed and non-limiting description on an embodiment thereof, with reference to the attached drawings, wherein:

- figure 1 shows a cross-sectioned top view of the mattress according to the present invention;
- figure 2 shows and enlarged view sectioned along plane II-II of figure 1; and
- figure 3 shows a scheme of the mattress of figure 1.

Referring to figure 1, it is seen that the mattress according to the present invention comprises in a known way an external cover 1 in which a padding 2 including one or more air chambers 3 suitable for being inflated for supporting the body of at least one user is arranged. In the present embodiment, padding 2 has a substantially parallelepiped shape with four side walls and a base of polyurethane foam. The air chambers 3 have a substantially parallelepiped shape and are arranged in padding 2, between its side walls and above its base, along more horizontal rows and columns so as to form at least one uniform layer of alveoli. For example, the present embodiment of the mattress, single and having a standard size, comprises sixteen rows by forty columns of air chambers 3, which are in turn grouped into four groups of air chambers 3 mutually connected in each group. These four groups of air chambers 3 correspond to the head zone A, the lumbar zone B, the sacral zone C and the leg zone D of the user, respectively, wherein the depth of the latter zone is greater, in particular substantially twice, than the depth of any other zone A, B or C. For example, zones A, B and C comprise eight columns of air chambers 3 and zone D comprises 16 columns of air chambers 3.

According to the invention, the air chambers 3 are connected by means of air inlets 4 and to an electric control device 5 which is suitable for controlling and

air chambers 3 with the outside, as well as to an automatic switch 18, for example a relay or a transistor, arranged along an electric line between compressor 12 and an electric power source 19, in particular a battery. The electric valves 14, 16 are normally closed and the automatic switch 18 is normally open, so as to save electric energy during the use. The control unit 15 opens or closes the electric valves 14 or 16, as well as the controlled switch 18 according to control signals coming from a plurality of pressure sensors 20, each connected to a group A, B, C or D of air chambers 3 and preferably arranged on the side opposite to inlets 4 and/or outlets 17. The control unit 15 is provided or connected with at least one digital memory 21 suitable for storing some pressure values of the groups A, B, C and D of air chambers 3 and can communicate with an external remote control 22, for example through a radio transceiver 23 or a cable. The remote control 22 is provided with a display 24, for example LCD, a keyboard 25 and a power switch 26, as well as with other electric and/or electronic devices, also of the known kind, which are necessary for its working, such as batteries, connection and power circuits, control units and/or a transceiver for the exchange of control signals with transceiver 23.

During the use, the control unit 15 compares the signals coming from the pressure sensors 20 with a series of pressure values stored in the digital memory 21. These values can correspond to a series of standard pressure values or to values preset by the user.

The following table shows an example of the minimum and maximum standard values expressed in Pa in each group A, B, C, and D of air chambers 3 according to the total user's weight.

modifying the air pressure in the air chambers 3 and is arranged in a space made in padding 2, for example in a side wall thereof, so as to be accessible from the outside.

Referring also to figure 2, it is seen that the air chambers 3 are preferably obtained by an upper sheet 6 of a deformable material, for example natural lattice or neoprene, PVC or polyurethane, which is shaped so as to form a plurality of alveoli with a substantially parallelepiped shape which are open downwards and are mutually connected by stripes of the same material along their lower edges. A lower sheet 7 of a deformable material, for example the same material of the upper sheet 6, is welded along said stripes so as to hermetically close the alveoli and to obtain the air chambers 3. In each of the four groups A, B, C and D, the air chambers 3 communicate with one or more adjacent air chambers 3 through a slit 8 made between the upper sheet 6 and the lower sheet 7. Slit 8 is obtained by preventing the welding between the two sheets 6, 7 along a portion of the stripe which joins the lower edges of the relevant alveoli, for example by arranging a tape of an non-adhering material under the upper sheet 6 and/or on the lower sheet 7 in the zone of the stripe in which slit 8 is desired, or by obtaining a thin canal, preferably with a section lower than 1 mm^2, during the shaping of the alveoli in the upper sheet 6.

Reinforcing members 9 which have a complementary shape and a smaller size with respect to the inside of the air chambers 3 and are made of a deformable material, for example polyurethane foam, are further arranged in the air chambers 3 for assuring that they maintain a minimum volume even if deflated. A flexible net 10, for example made of nylon, which distributes the load from the top on a wider surface, as well as a sheet 11 of a deformable material, for example polyurethane foam with closed cells, which maintains the deformed shape for a determinate period, in particular at least 10 seconds, are arranged on the air chambers 3 so as to improve the user's comfort.

With reference to figure 3, it is seen that the control device 5 suitably comprises an electric compressor 12 which can suck air from the outside through a duct 13 and pump it through inlets 4 into one or more groups A, B, C and/or D of air chambers 3. Inlets 4 are provided with an electric valve 14 connected to an electronic control unit 15, for example provided with a microprocessor. This control unit 15 is connected also to electric valves 16, arranged along outlets 17 which connect the groups A, B, C and D of